
AGRICULTURAL RESEARCH, PRODUCTIVITY, AND TECHNICAL CHANGE

S u m m a r y

U.S. agricultural productivity growth has been rapid compared with other sectors of the economy. Agricultural productivity has grown at 1.8 percent per year since 1948 whereas productivity in the non-farm economy grew at only 1.1 percent.

Public agricultural research has been a major contributor to productivity growth and has been a solid public investment, earning a return of at least

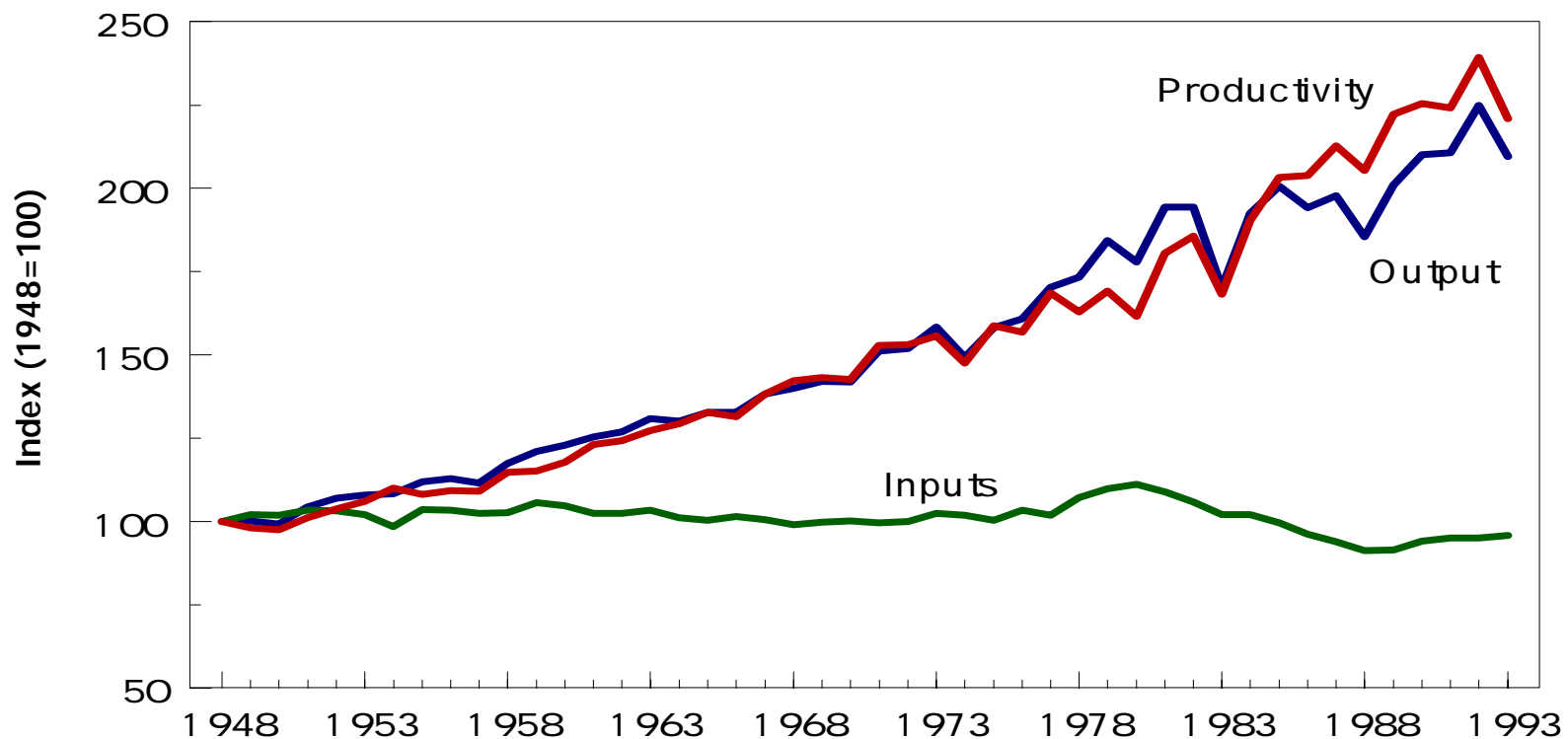
35 percent. Private expenditures on agricultural research have grown more rapidly and now exceed public expenditures.

Yield growth in major field crops has been rapid ranging from 1 to 3 percent per year. Yield growth for corn, sorghum, and potatoes has been most rapid. Yield growth for non-hybrid crops has been slower. Some have argued that crop yield growth slowed in

the 1980s but the evidence is mixed.

With little or no increase in public agricultural research expenditures over the past decade and little reason to expect increases in the future, maintaining yield growth and meeting other research objectives will mean better targeting existing public research expenditures and creating incentives for the private sector to fund research.

U.S. Agriculture: Inputs, Outputs and Productivity



Productivity and Agricultural Research

- Productivity in the farm sector has grown at 1.8 percent per year

since 1948 compared with 1.1 percent in the non-farm economy.

- Rates of return to public agricultural research have been high--the

marginal rate is at least 35 percent. One of the major implications is that yield growth has been rapid for major field crops.

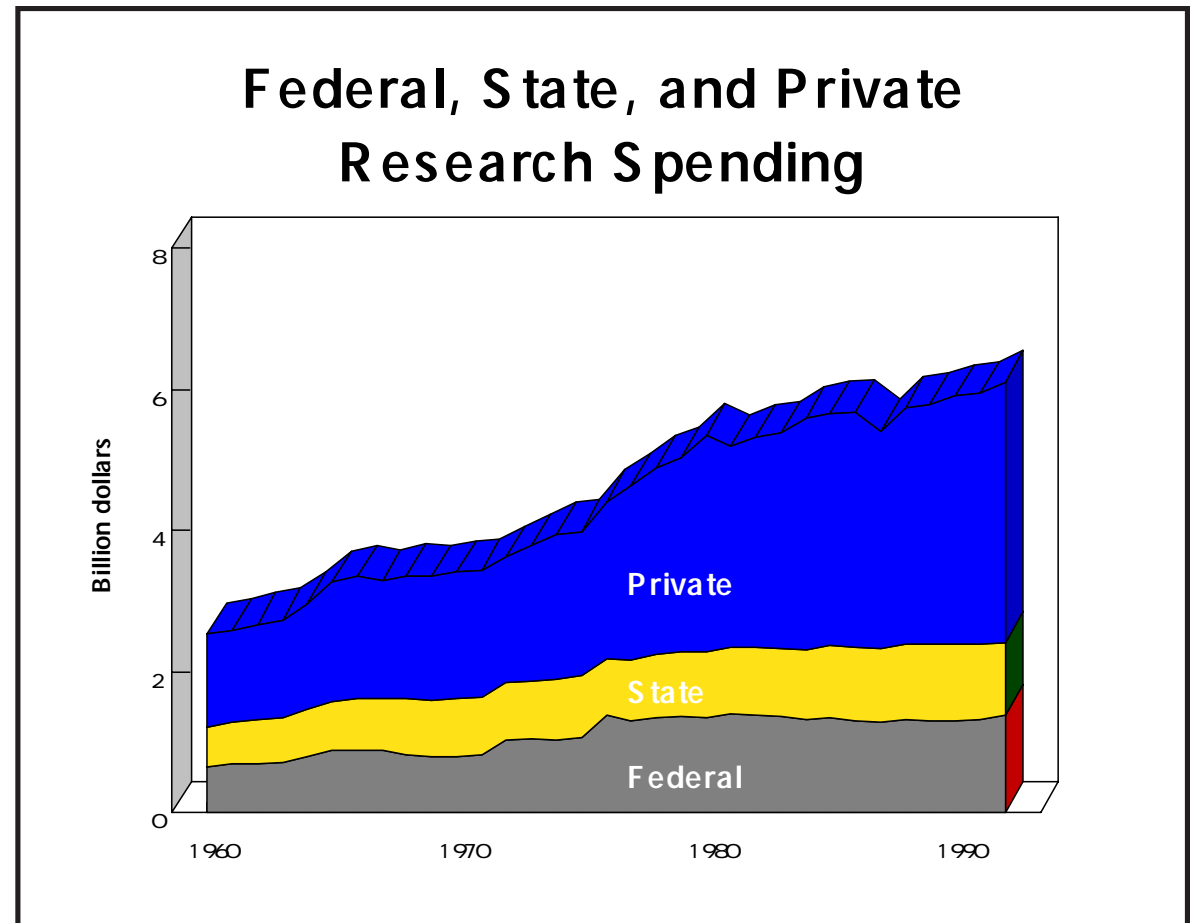
Looking Forward: Challenges for Agricultural R&D

- U.S. public agricultural R&D spending has been flat in real terms over the past ten to 15 years. While the evidence is mixed, there is concern whether worldwide yield growth can keep pace with demand. Failure to do so could increase demand for U.S. agricultural production and put significant pressure on natural resource use and the environment.
- R&D spending on natural resource management in agriculture has grown modestly since 1982 in contrast to trends in the general economy.
- Public funding must increasingly be focused on those areas where the private sector will not fund research.

Public Agricultural Research Has Been Stagnant...

...but private sector research has grown rapidly. Since 1980, more than half of all agricultural research funds are from the private sector.

- Public (federal plus state) agricultural research expenditures grew in real (inflation-adjusted) terms by 3-4

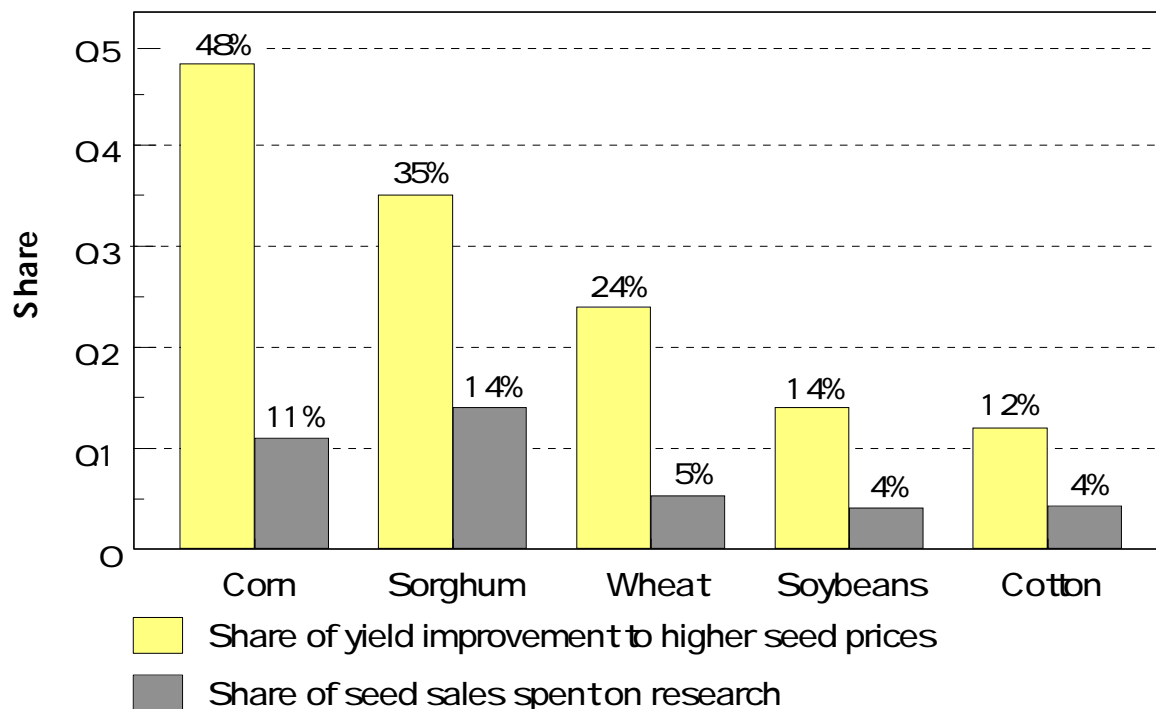


percent per year before 1980, but yearly growth has slowed to less than 1 percent thereafter. Federal expenditures have been stagnant since 1976.

Incentives for Private R&D Investments are Increasingly Important to Agriculture's Future

- For crops grown with hybrid seed, such as corn and sorghum, seed companies have been able to capture between one-third and one-half of the

Appropriating Gains from Research: Private Investment in Plant Breeding



- Patenting of biological inventions and changes in the U.S. Plant Variety Protection Act may increase private incentives.

Crop Yield Trends are of Increasing Concern

- Yield growth has been rapid for major field crops. Since 1939, corn yields have grown about 3.0 percent and wheat yields about 1.8 percent per year.
- Yield growth for hybrid crops, where private research incentives have been stronger, have been

value of improved varieties by charging higher seed prices.

- For crops grown from non-hybrid varieties, such as soybeans, cotton, and wheat, seed companies appear to be capturing less than one-fourth of

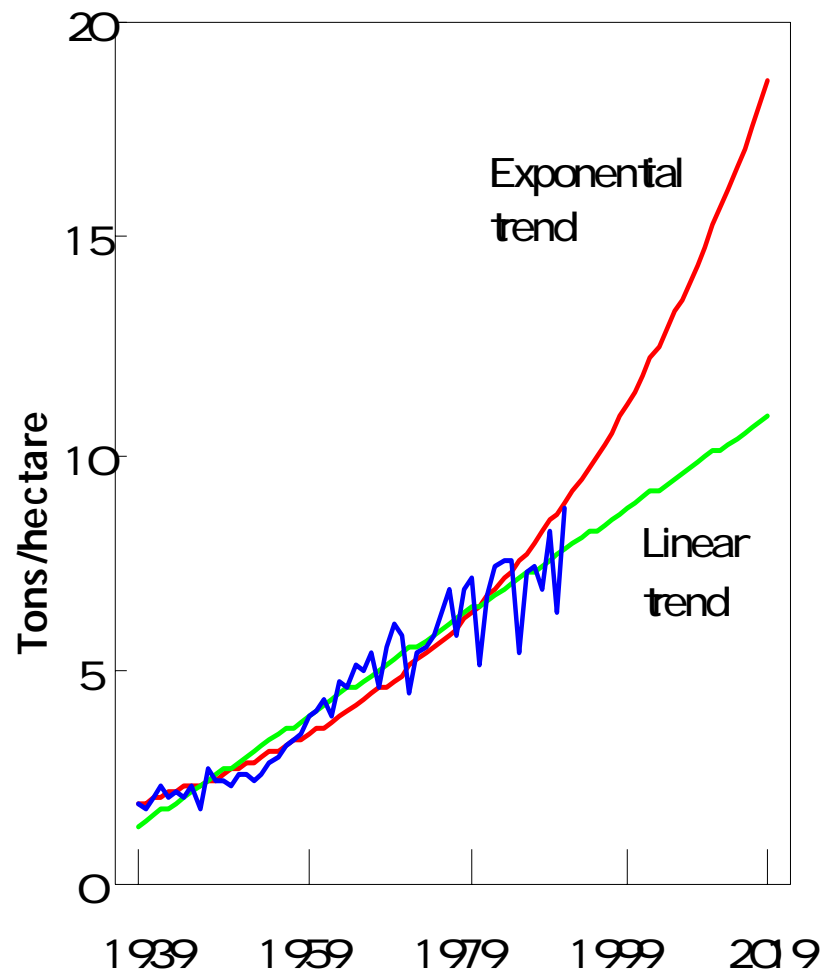
the gains from plant breeding.

- Evidence suggests that only about 5 percent of the value of seed sales is reinvested in research.

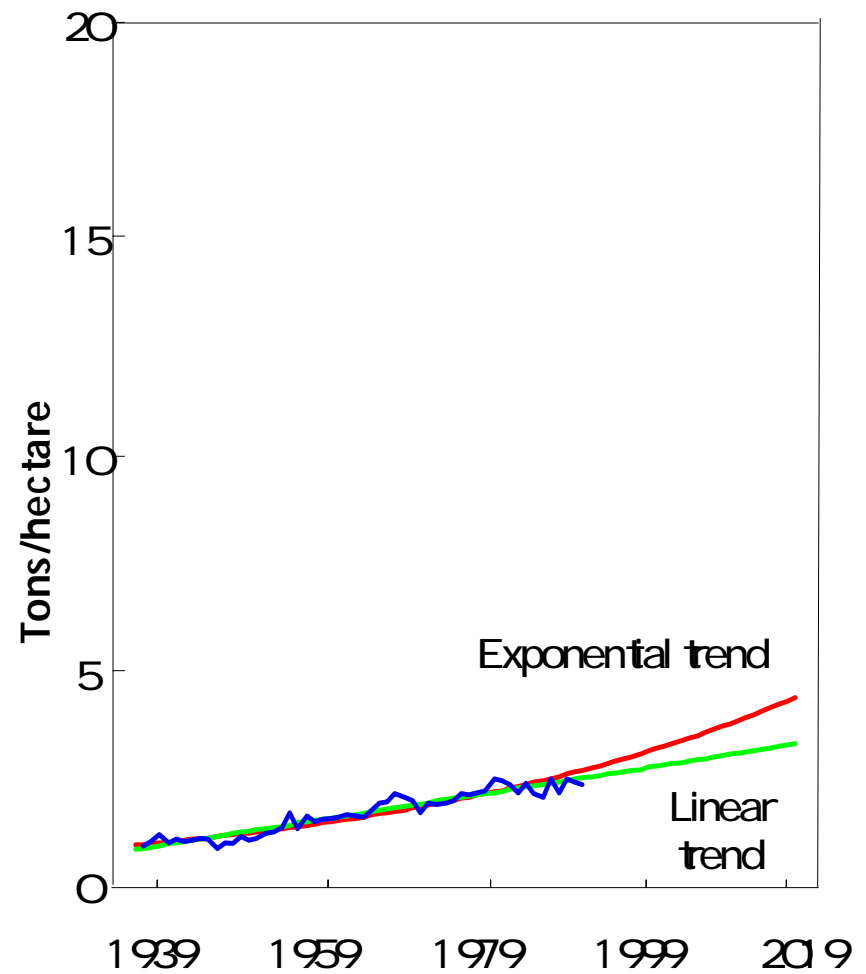
faster.

- There is no strong evidence of a yield plateau for major field crops, but is also unclear whether yields are rising at a linear or exponential rate.

U.S. Corn Yield Trends



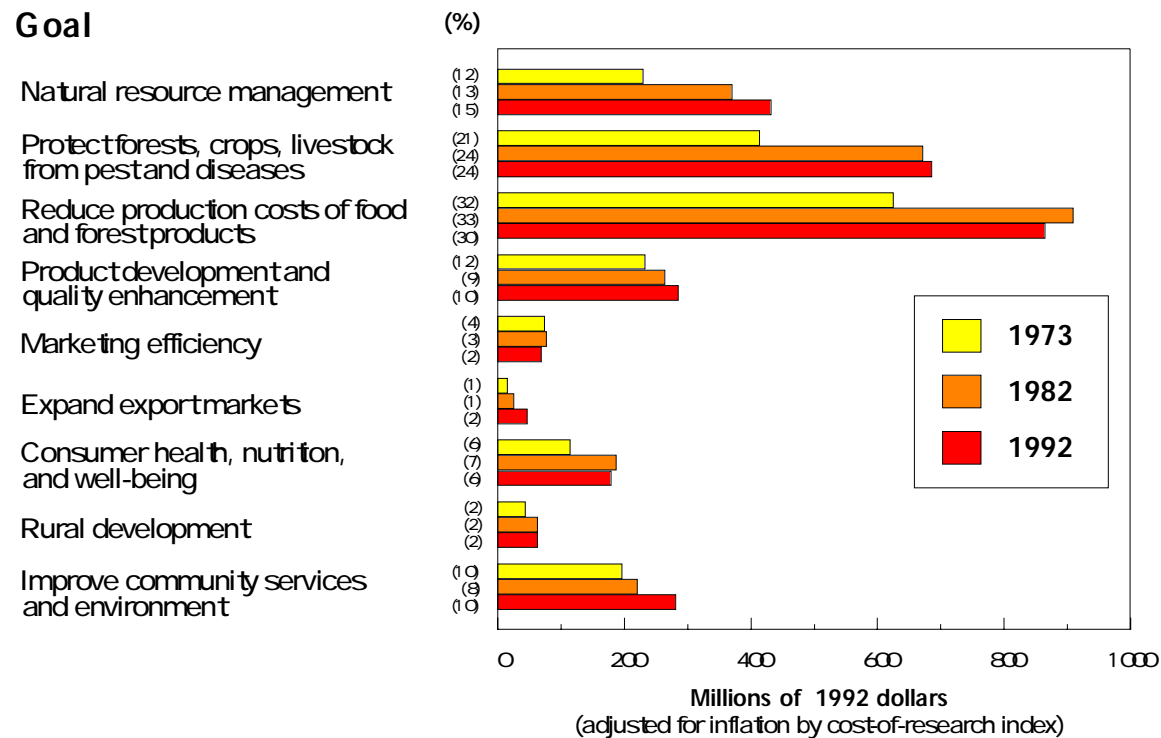
U.S. Wheat Yield Trends



R&D Spending on Natural Resources in Agriculture Has Increased

- Research expenditures by the U.S. federal-state agricultural research system are allocated into nine broad goals.
- Allocation among the nine goals has remained fairly constant over the past twenty years. More than 70 percent of research is spent for the first three goals (see graph).
- Expenditures for natural resource management have increased modestly in real dollars and as a share of total R&D.

Allocation of Public Expenditures for Agricultural Research



Suggested reading on the U.S. system of agricultural research:

Fuglie, Keith, Nicole Ballenger, Kelly Day, Cassandra Klotz, Michael Ollinger, John Reilly, Utpal Vasavada, and Jet

Yee. *Agricultural Research and Development: Public and Private Investments Under Alternative Markets and Institutions*, Agricultural Economic Report 735, USDA, Economic Research Service, May 1996.